



**NTSB** National Transportation Safety Board

---

# Thoughts on General Aviation Risk Management

Earl F. Weener, Ph.D.  
Member, NTSB



NBAA Single Pilot Safety Stand-down  
Orlando FL  
October 31, 2016



# N6529R - B36TC Bonanza



# NTSB Mission

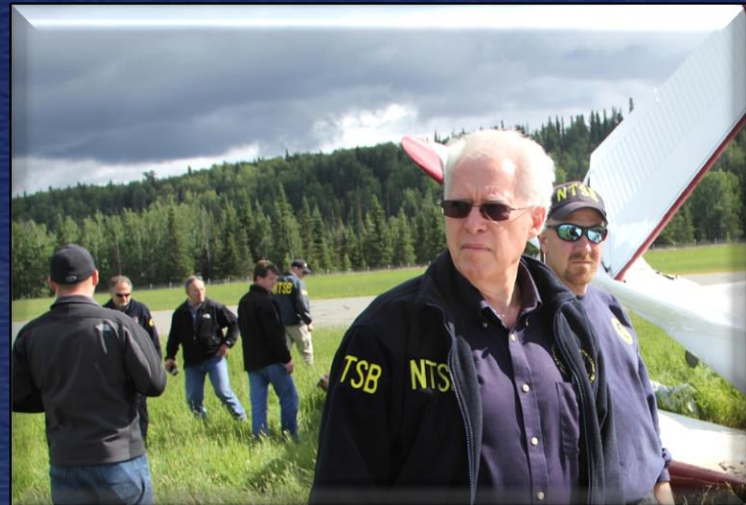
The NTSB is an independent U.S. Federal agency charged with:

- Determining the probable cause(s) of transportation accidents (aviation, rail, highway, marine & pipeline)
- Making recommendations to prevent their recurrence
- Conducting special studies and investigations
- Coordinating resources to assist victims and their families after an accident



# NTSB's Multi-Modal Mandate

- Maintain congressionally mandated independence
- Conduct objective accident investigations and safety studies
- Perform fair & objective airman/mariner certification appeals
- Advocate safety – NTSB Most Wanted List, recommendations



NTSB





# NTSB 2016 Most Wanted List



- Disconnect from Deadly Distractions
- End Substance Impairment in Transportation
- Expand Use of Recorders to Enhance Transportation Safety
- Improve Rail Transit Safety Oversight
- Prevent Loss of Control in Flight in General Aviation
- Promote Availability of Collision Avoidance Technologies in Highway Vehicles
- Promote the Completion of Rail Safety Initiatives
- Reduce Fatigue-Related Accidents
- Require Medical Fitness for Duty
- Strengthen Occupant Protection

# Gray Summit, MO – Bus/Truck/Tractor Crash





# Distraction



# Distraction





# Distraction



# 2016 MWL - *Disconnect from Deadly Distractions*

A factor in all modes of transportation:

- Motor vehicle emphasis
  - Electronic devices within the vehicle
- Aviation emphasis
  - Sterile Cockpit
  - Appropriate use of PEDs
  - Manage distractions



# End Substance Impairment



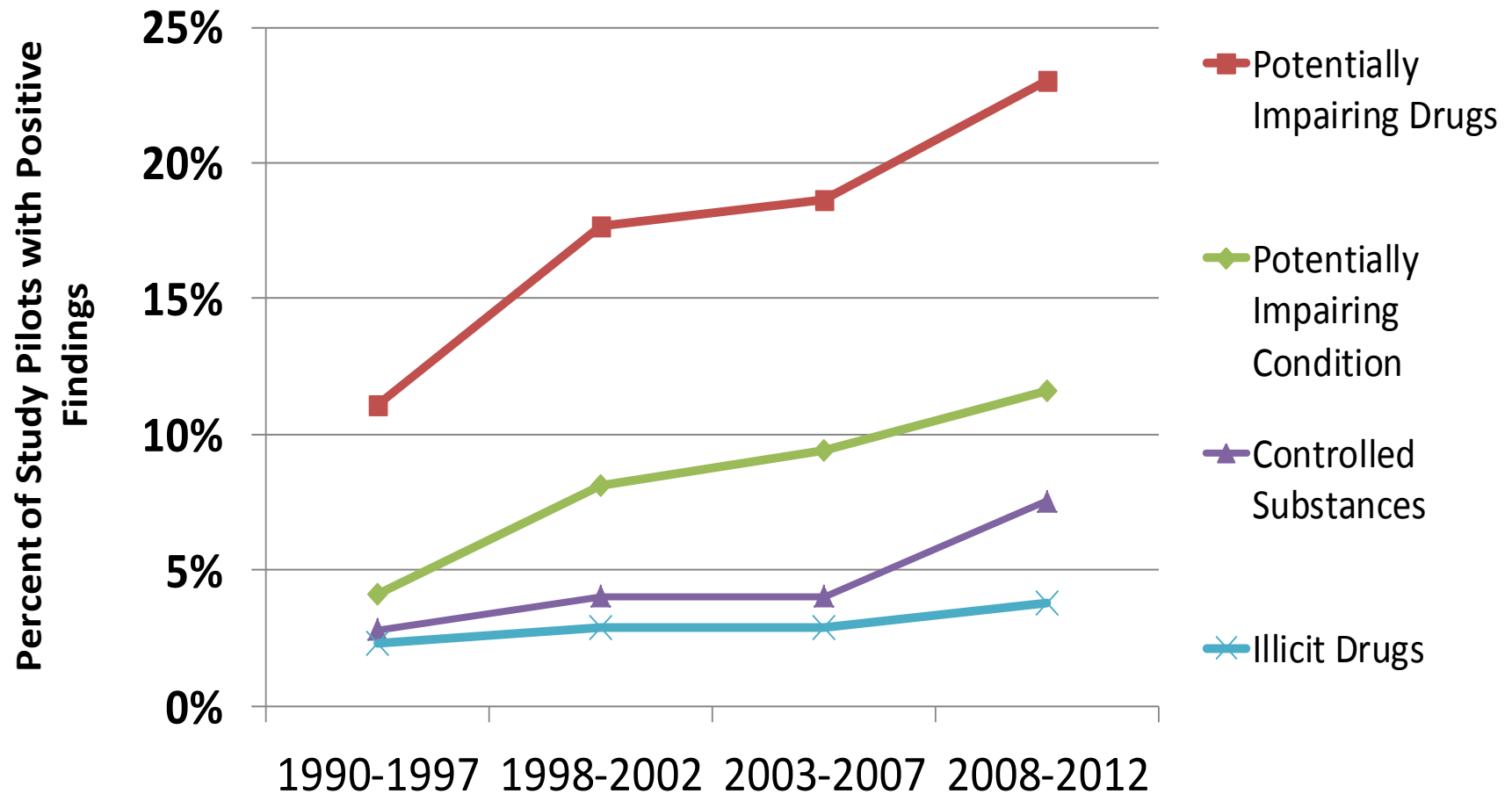
# 2016 MWL - *End Substance Impairment in Transportation*

A factor in all modes:

- Fatally injured pilots - potentially impairing drugs
  - 11% average 1990 - 1997
  - 23% average 2008 - 2012

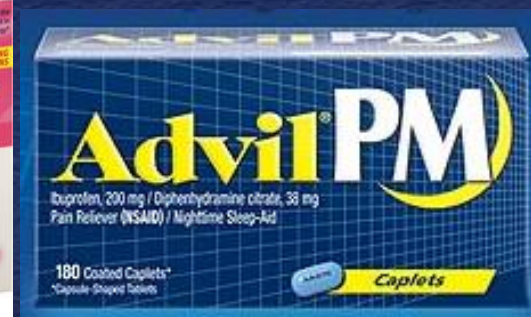


# Toxicology Findings by Category, 1990-2012



# Most Common Drugs

- Sedating antihistamines
  - Most common category
- Diphenhydramine
  - Most common individual drug
  - Most common potentially impairing drug
  - Use INCREASING





# Medical Fitness for Duty





# Medical Fitness for Duty





# 2016 MWL – *Require Medical Fitness for Duty*

A factor in all modes:

- Airman Medical – fitness at exam point
  - Pilots must self-assess fitness
- Undiagnosed or unreported medical conditions pose threats
  - Obstructive Sleep Apnea
  - Diabetes
  - High Blood Pressure

# Reduce Fatigue Related Accidents





# Bronx Bus Crash, March 12, 2011



15 KILLED  
17 INJURED



# Cranbury, New Jersey, June 7, 2014



**6 VEHICLES**

**21 PEOPLE**

**5 RECEIVED MINOR INJURIES**

**4 RECEIVED SERIOUS INJURIES**

**1 PERSON KILLED**



# 2016 MWL - Reduce Fatigue - Related Accidents

A factor in all modes:

- 182 Major investigations (2001 – 2012)
  - 20% involved fatigue
- Need
  - Research, education, training
  - Technology development
  - Hours of service, on/off duty policies
  - Fatigue risk management systems
  - Medical treatment of sleep disorders



# Loss of Control





# Loss of Control



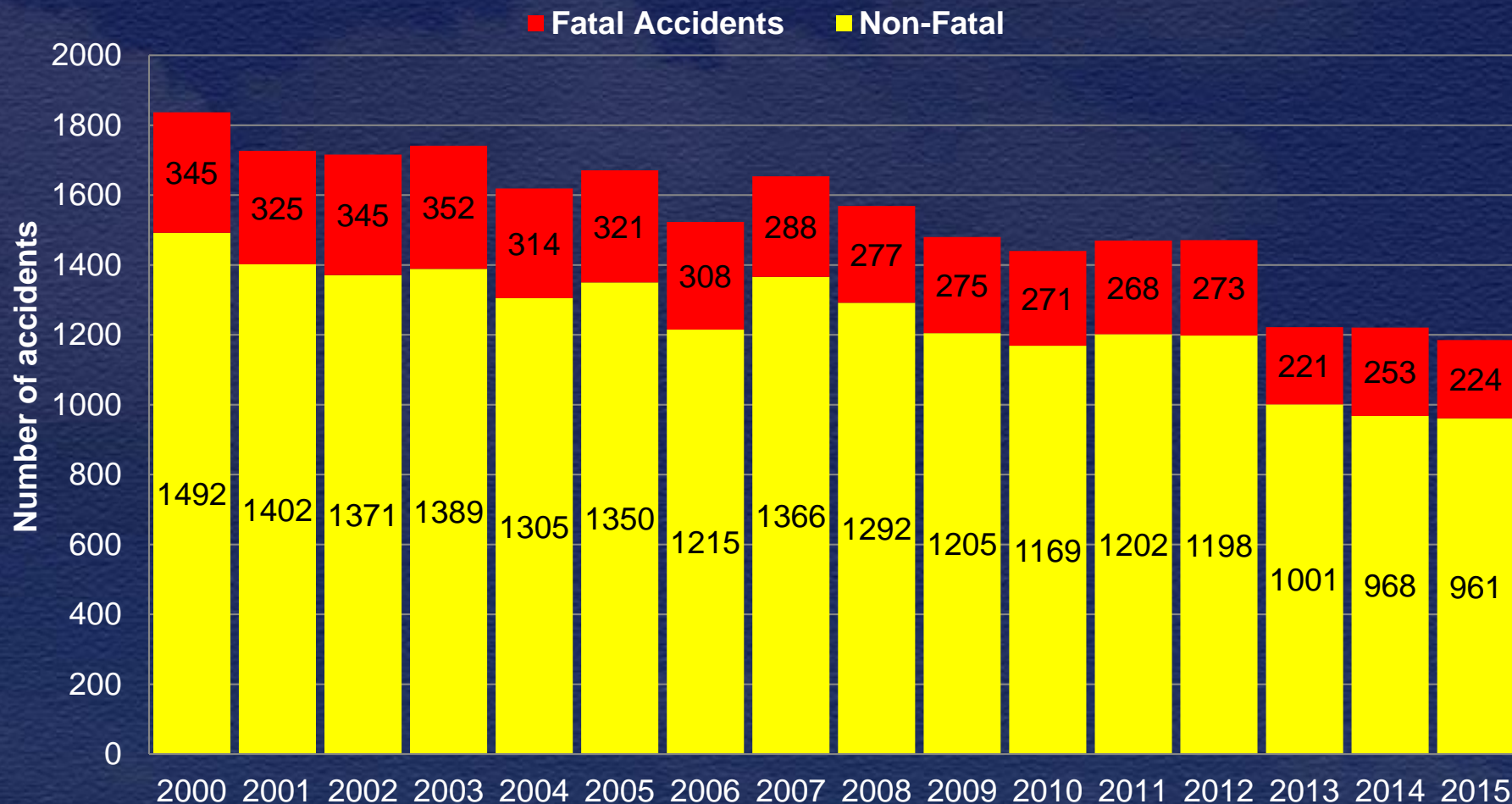


# 2016 MWL – Prevent Loss of Control in Flight in General Aviation

- More than 40% fatal GA accidents were LOC during 2004 – 2014
- Most deadly flight phases
  - Approach to landing
  - Maneuvering
  - Climb

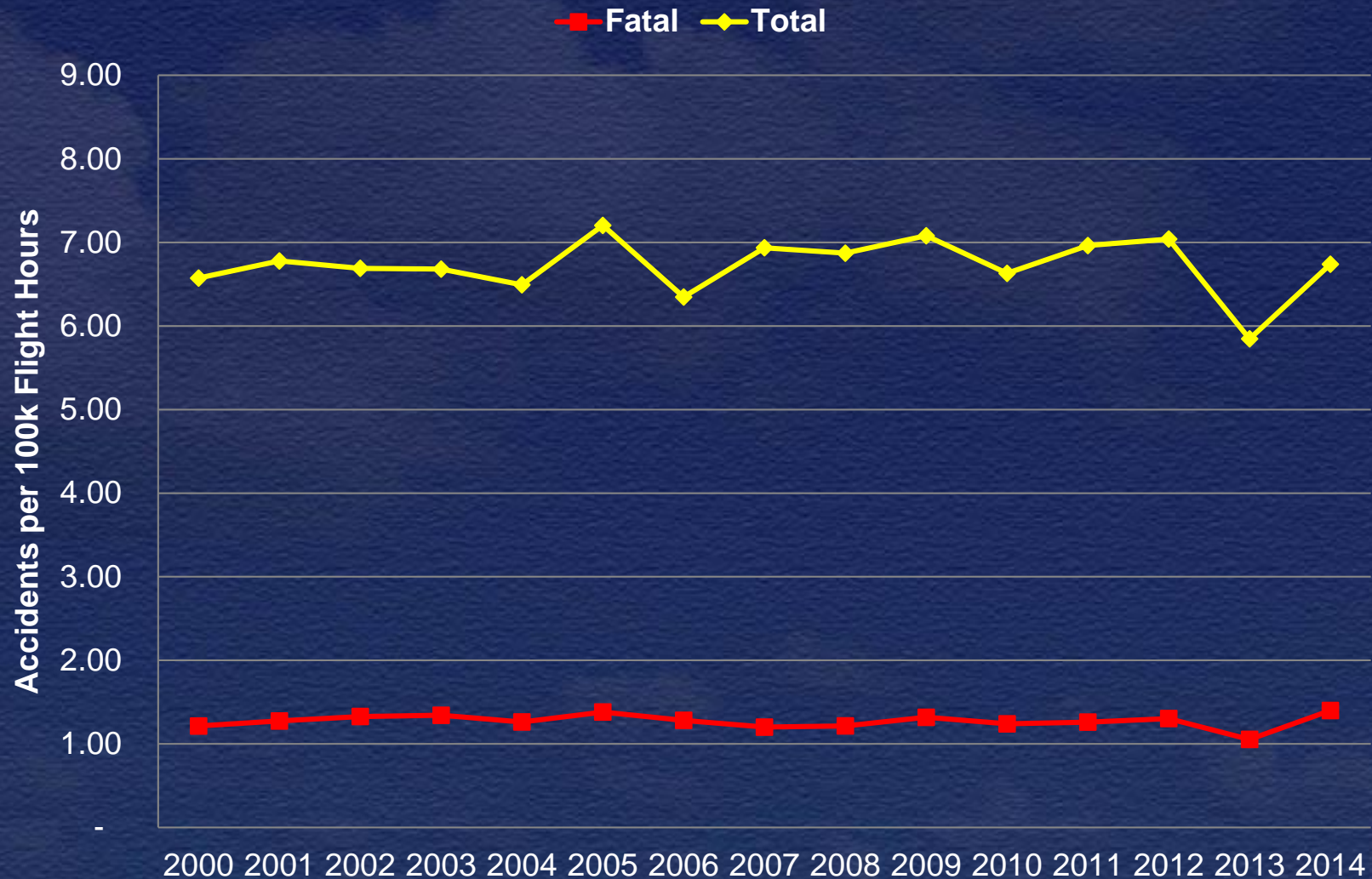


# All GA Accidents



\*2015 Preliminary numbers

# GA Accident Rates



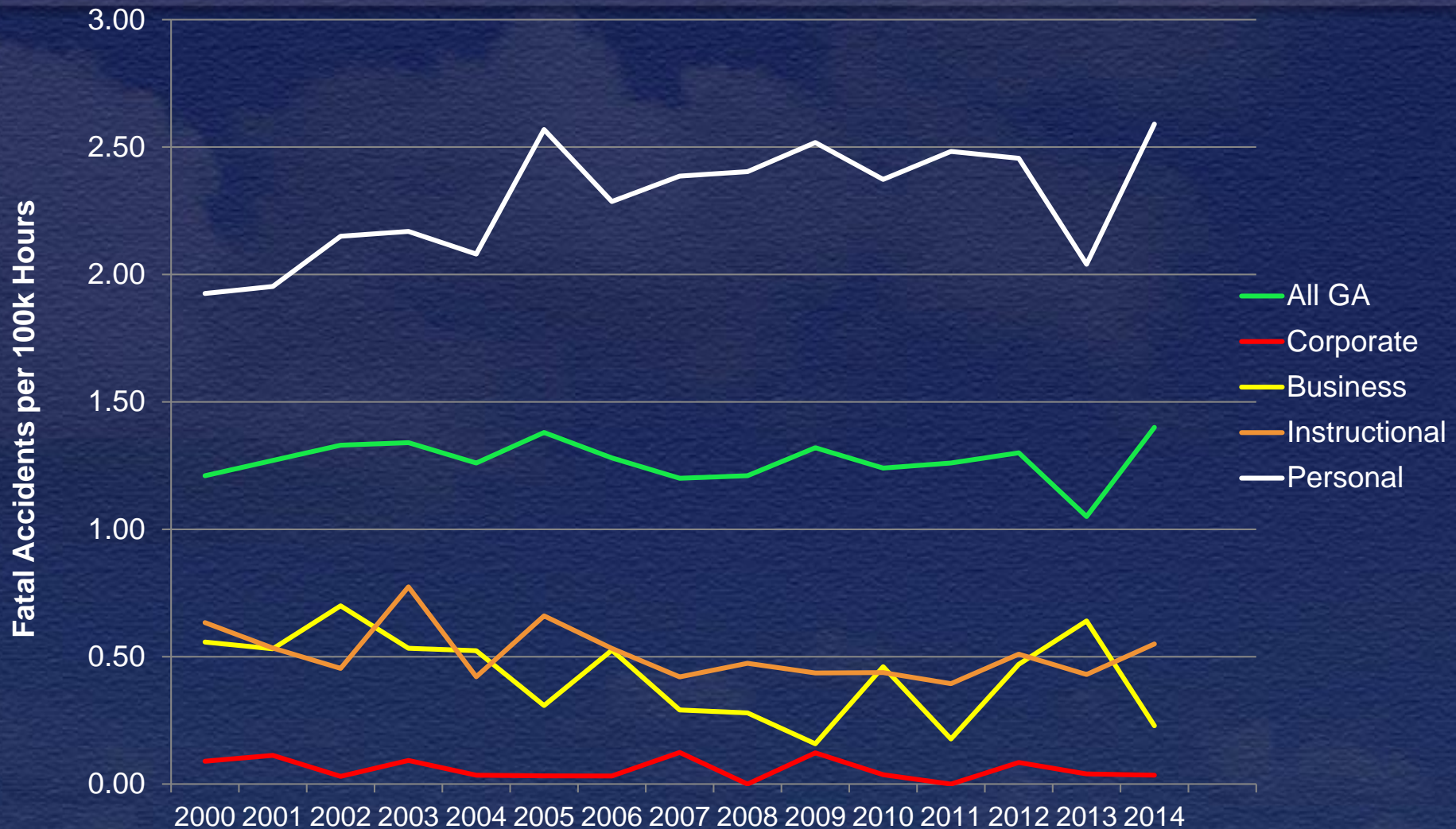
\*The 2011 GA Survey is currently not available. FAA is actively engaged in re-calibration efforts and expect to have validated 2011 data published at a later date.

NTSB



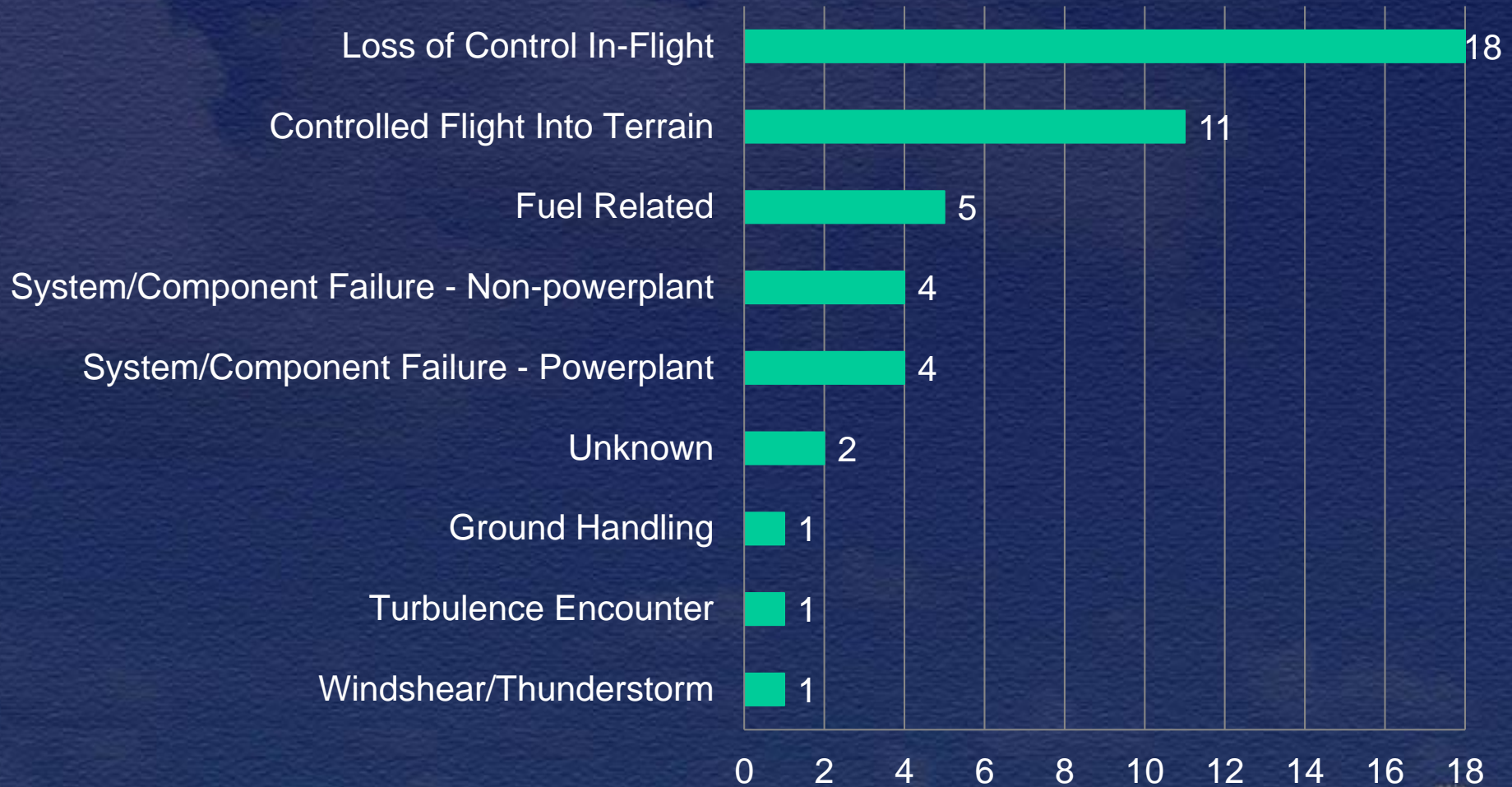


# Fatal Accident Rates per 100k Flight Hours



# Business Flying, 2008-2014

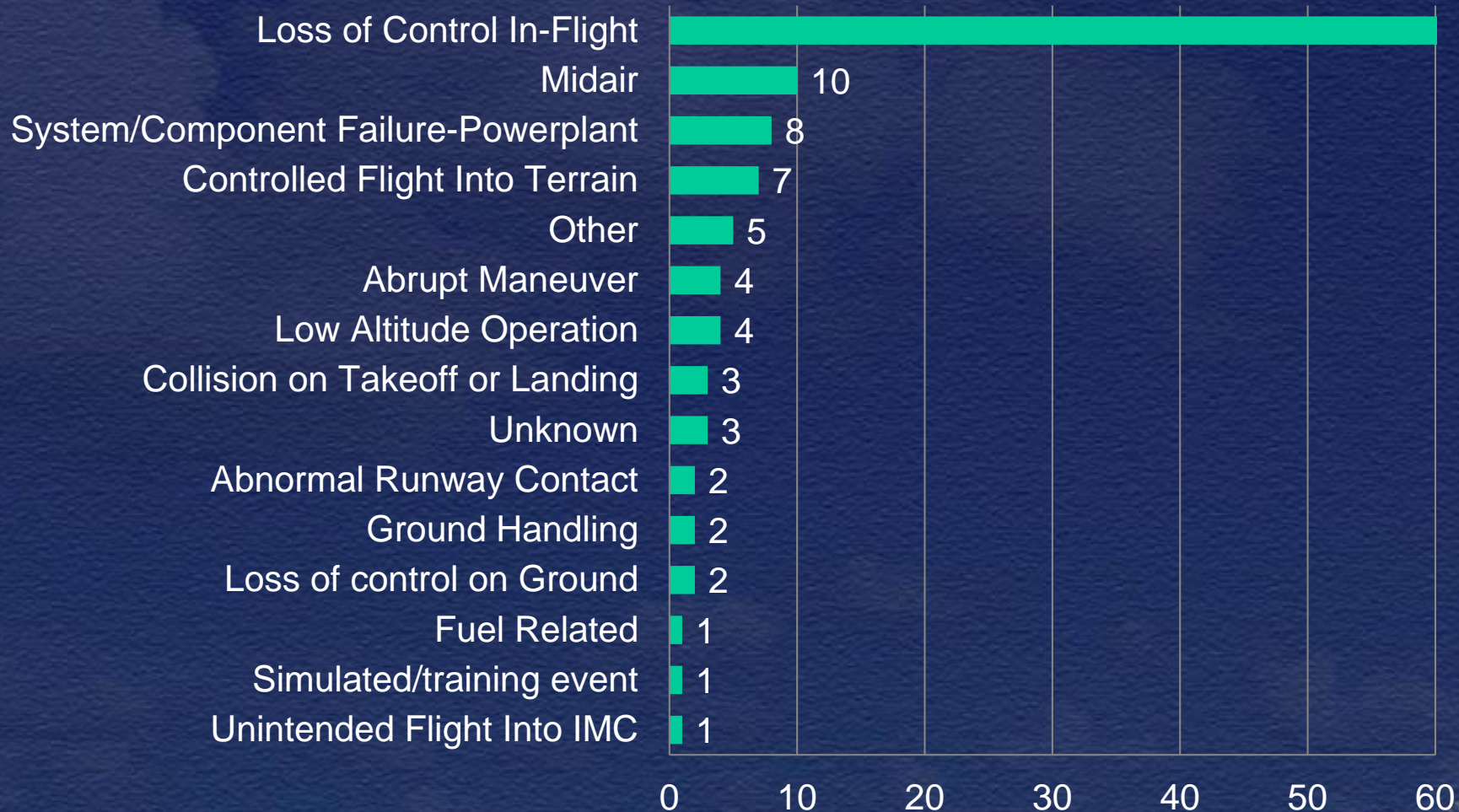
## Number of Fatal Accidents





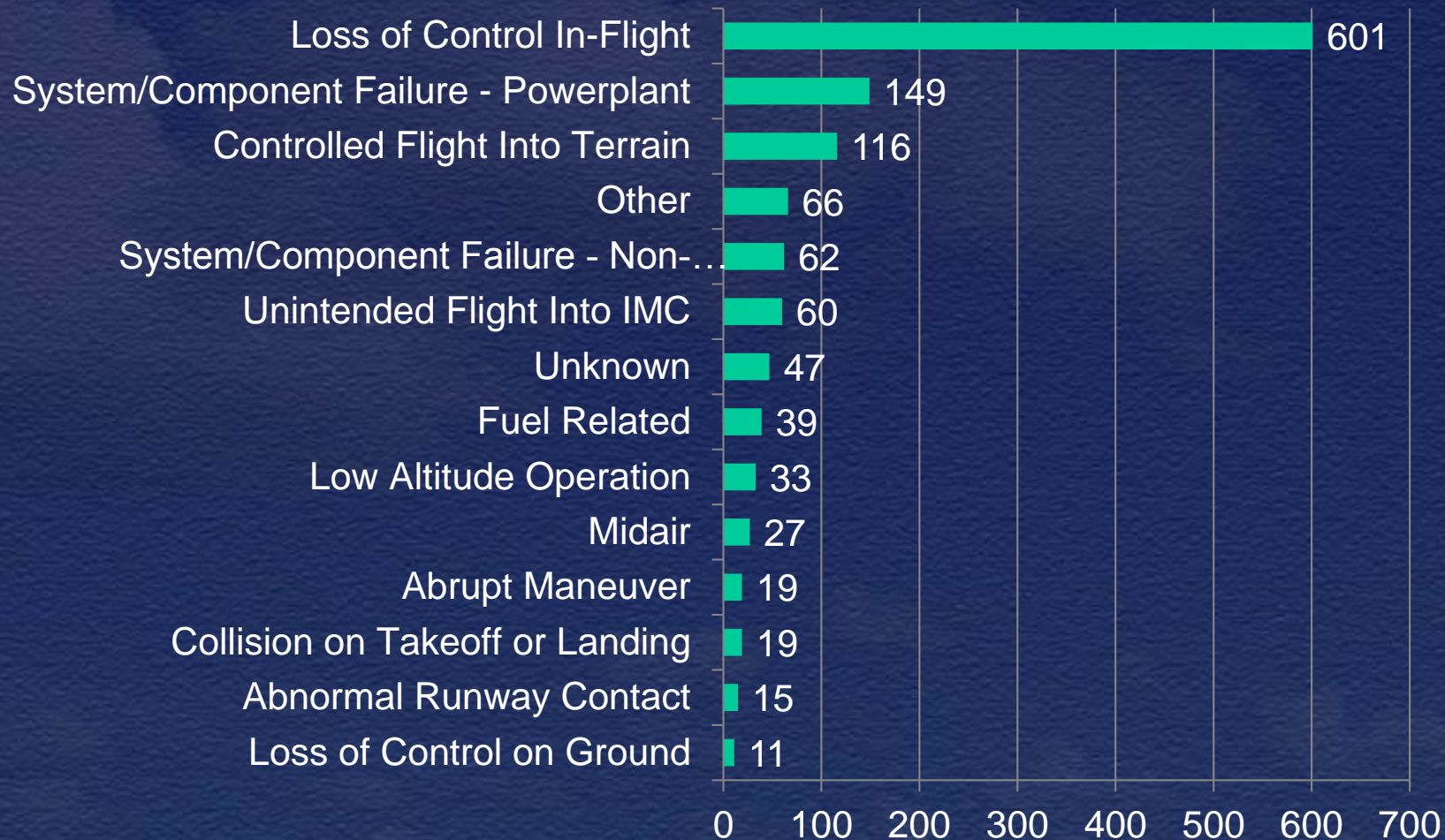
# Instructional Flying, 2008-2014

## Number of Fatal Accidents



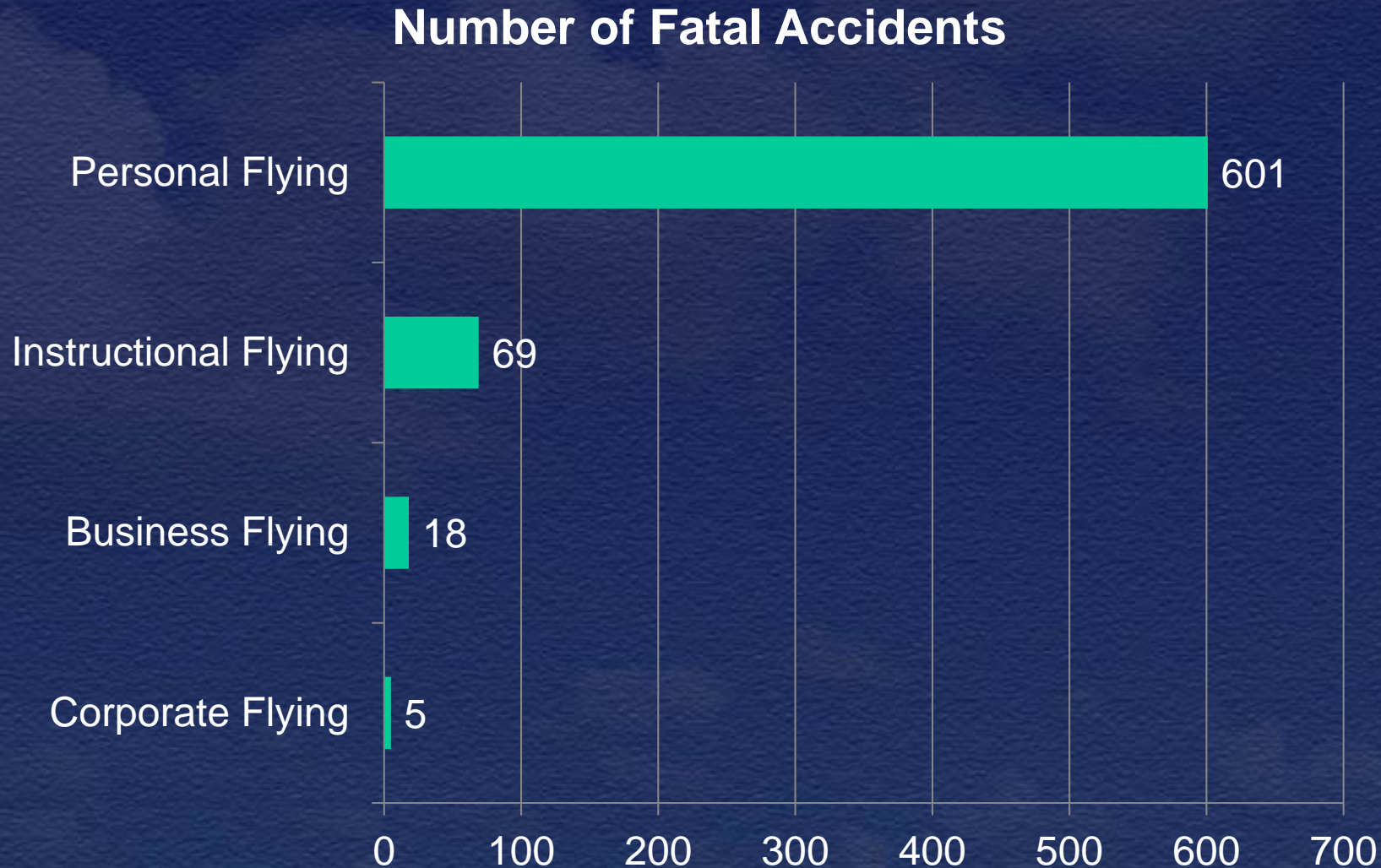
# Personal Flying, 2008-2014

## Number of Fatal Accidents





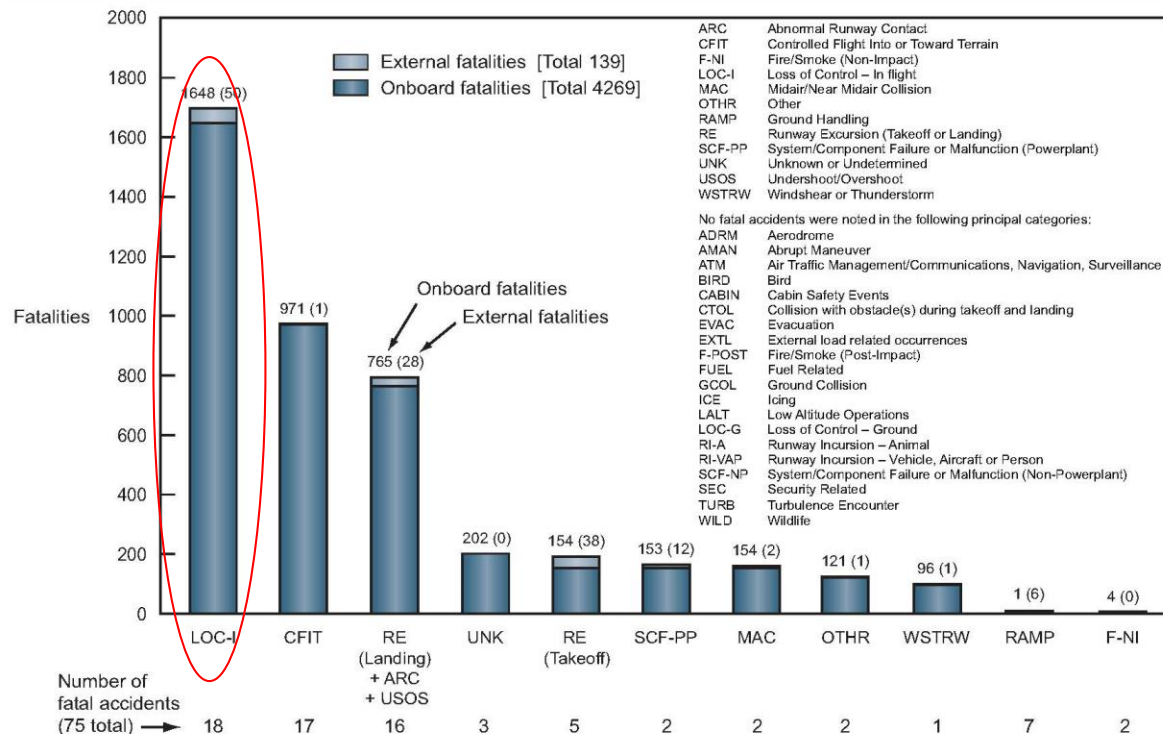
# Loss of Control In-Flight, 2008-2014



# Boeing Annual Statistical Summery

## Fatalities by CAST/ICAO Common Taxonomy Team (CICTT) Aviation Occurrence Categories

Fatal Accidents – Worldwide Commercial Jet Fleet – 2003 Through 2012



Note: Principal categories as assigned by CAST.

For a complete description of CICTT Aviation Occurrence Categories, go to: <http://www.intlaviationstandards.org/>





# DCA15MA029 - Embraer EMB-500

- Gaithersburg, Maryland  
December 8, 2014
- Tim LeBaron,  
Investigator-in-Charge
- NTSB Board Meeting  
June 7, 2016



# Participants to the Investigation

- Federal Aviation Administration
- ICAO Annex 13 Accredited Representatives
  - Brazil Aeronautical Accidents Investigation and Prevention Center (CENIPA)
    - Technical advisor - Embraer
  - Transportation Safety Board of Canada
    - Technical advisor - Pratt & Whitney Canada



# DCA15MA029 - Embraer EMB-500





# DCA15MA029 - Embraer EMB-500





# DCA15MA029 - Embraer EMB-500





# DCA15MA029 - Flight

- Pilot, 2 passengers and 3 people in the house fatally injured
- Instrument flight rules
- Operated under Part 91
- Go-team – launched



# Flight

- Combined Recorder (CVDR)
- Takeoff and cruise were uneventful
- 15 minutes in icing conditions
- On course and glidepath until 300' above ground level
- Airplane rolled right 21 degrees

# DCA15MA029 - Flight

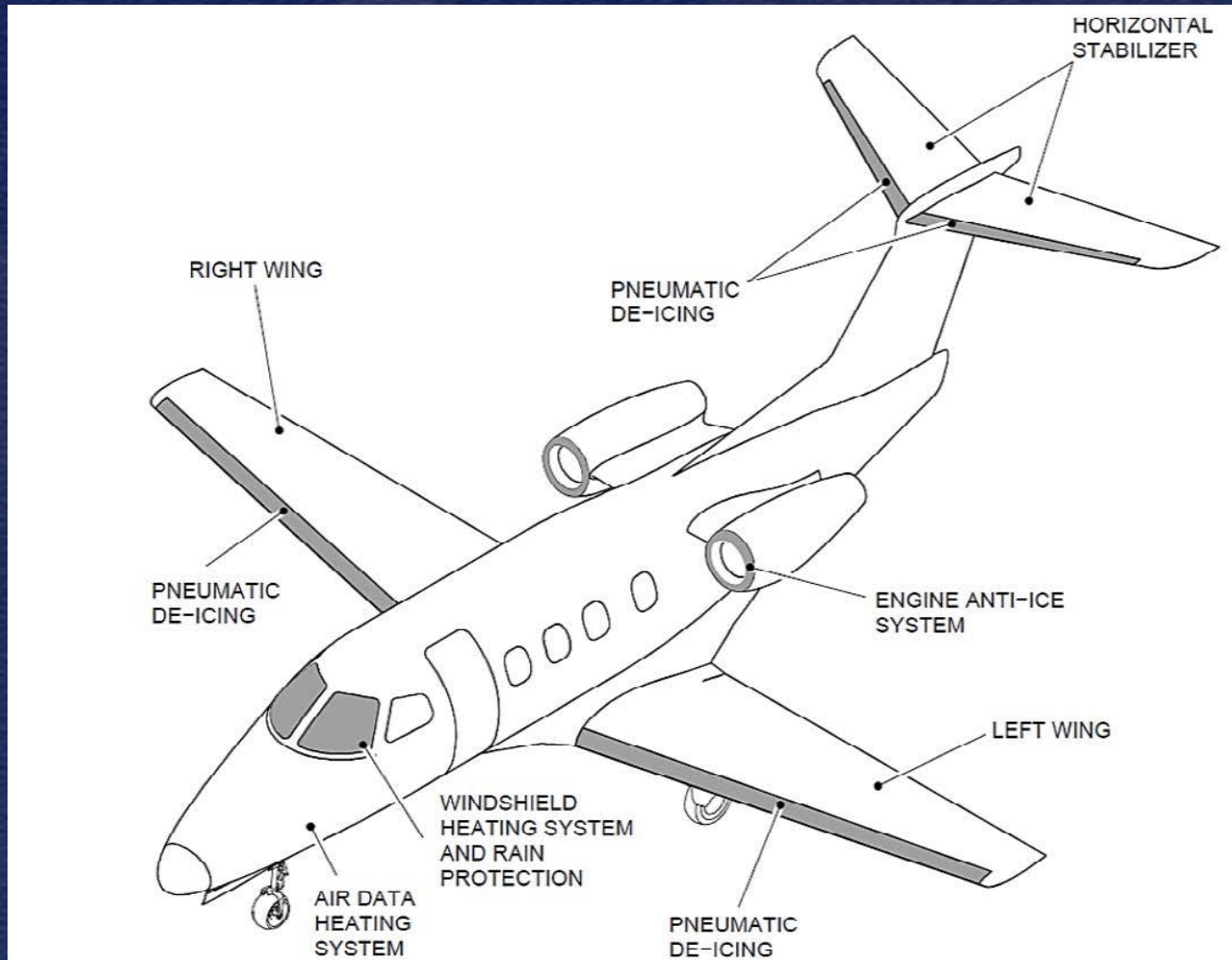
- 1 second later at 88 knots, aural stall warning sounded
- Stall warning continued
- Airplane went through series of roll oscillations
- Rolled more than 100 degrees before impact



# DCA15MA029 – Wing Deice



# EMB-500 – Certified for Icing

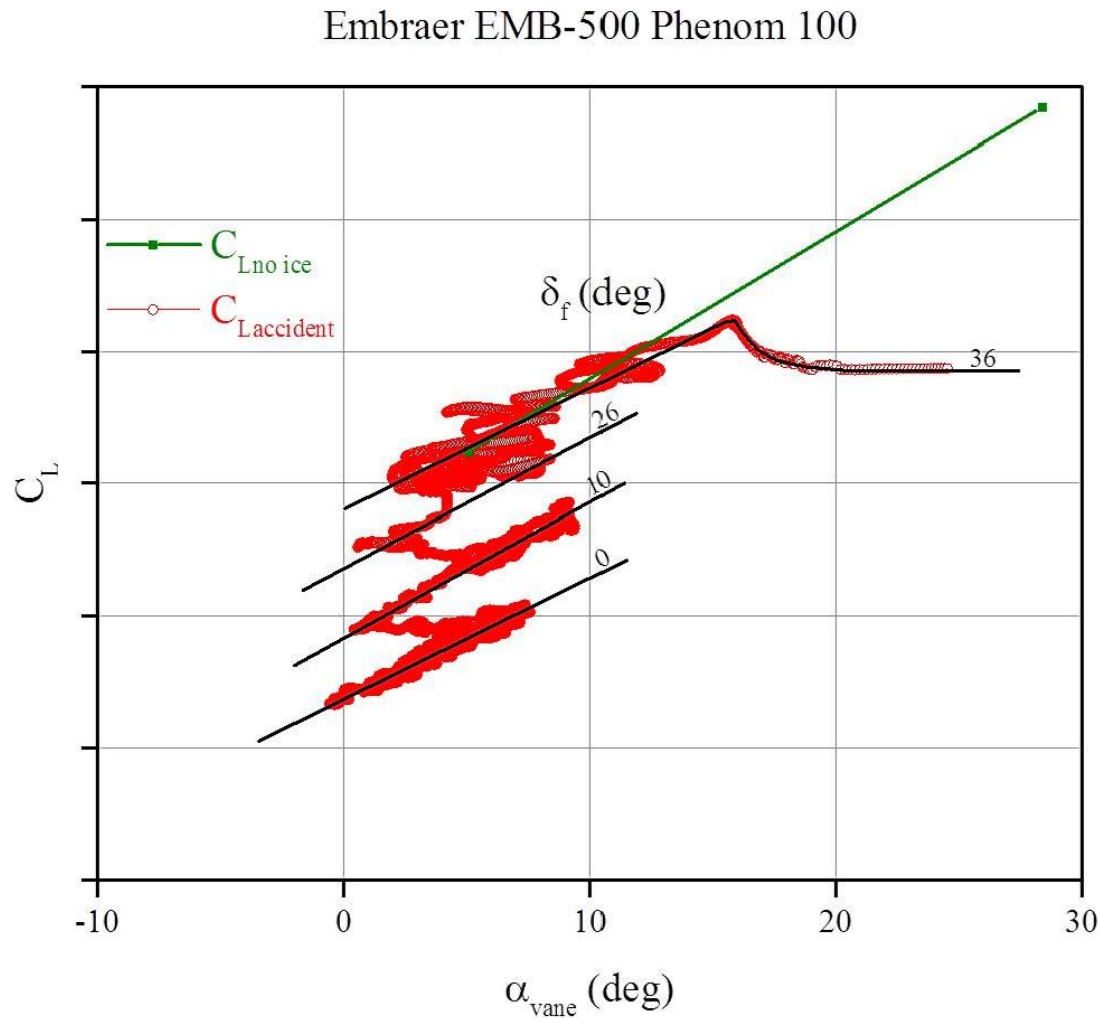




# Airplane Performance Study

- Analysis of accident flight data
- Wing without ice – Stall at approximately 28.4 degrees angle-of-attack
- Accident flight – Stall occurred at approximately 16 degrees angle-of-attack
- Stall characteristics consistent with ice accumulation

# DCA15MA029 – Lift versus AOA





# DCA15MA029 – Example Ice Shape

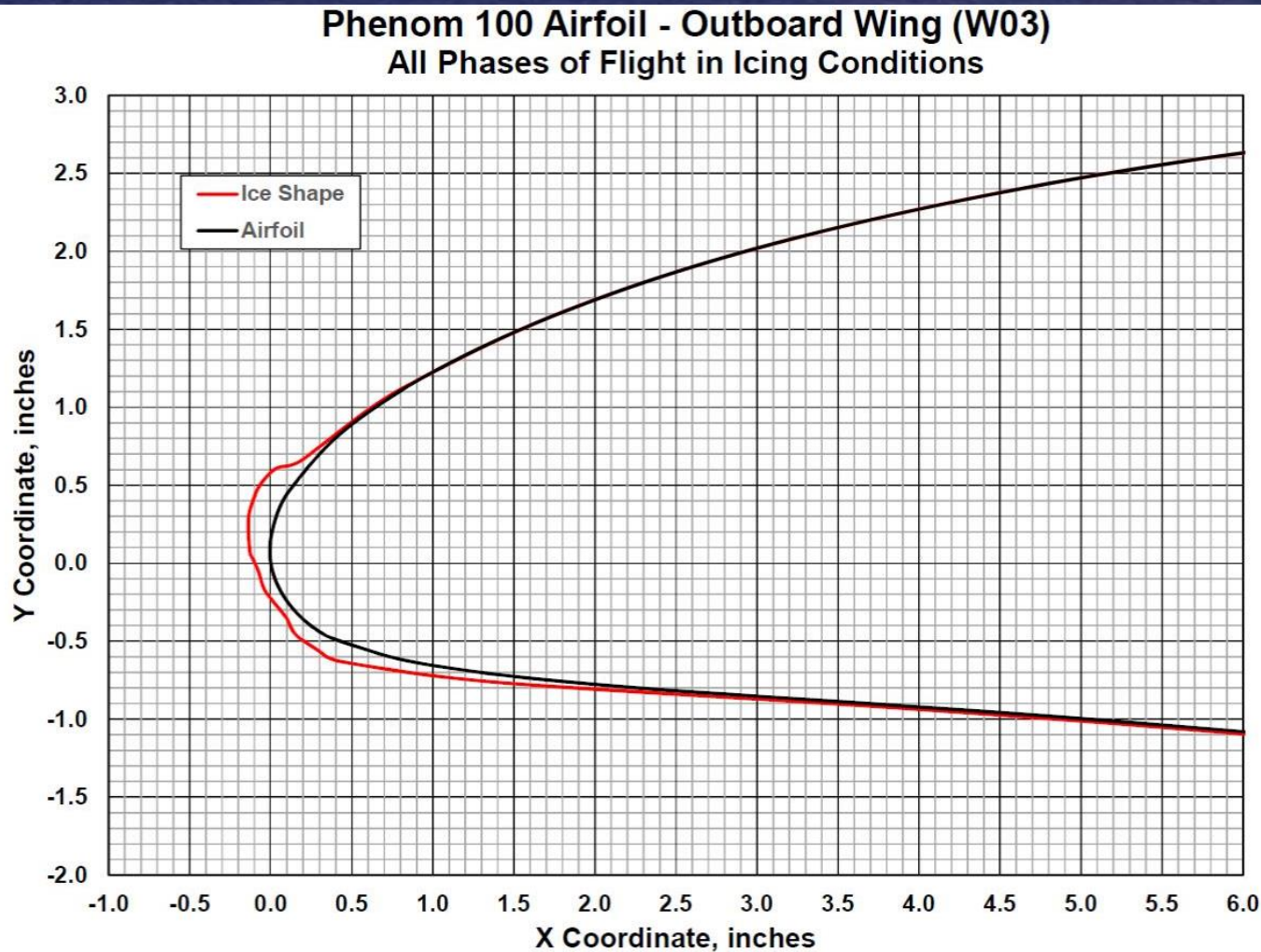


Figure 11. Airfoil and Ice Shape at Location W03 in the Icing Environment (Close-up)

# EMB-500 – Ice Protection Systems

- Pitot-Static System Heat – ON
- Engine anti ice system - OFF
- Wing / horizontal stabilizer deice pneumatic boot system – OFF
- Resultant: Stall at low altitude



# Safety Issues

- Single-pilot, turbofan, type rating
- Automatic alerting for icing
- Enhanced pilot training guidelines for flight in icing conditions

# Recommendations

## To NBAA

- Work with your members that are manufacturers and training providers of turbofan airplanes that require a type rating and are certified for single-pilot operations and flight in icing conditions to develop enhanced pilot training guidelines pertaining to risk management in winter weather operations, including the use of ice protection systems and adherence to checklists, with special emphasis given to deficiencies in pilot performance identified in this accident, and make the results of this effort available to the community of pilots who fly these airplanes.



# GA Joint Steering Committee

## Steering Committee

**Co-chairs** – Steve Gottlieb (FAA/AVP)  
Bruce Landsberg (AOPA/ASF)

**Government** – FAA (AFS, AIR, ATO, AAM & ARP)  
– NASA (Research),  
– NTSB (Observer)

**Industry** – GAMA, EAA, NBAA, NATA,  
SAFE, LAMA & Insurance

- Strategic guidance
- Management/Approval of Safety Plan
- Provide direction
- Membership Outreach
- Provides linkage to ASIAs

## Safety Analysis Team

**Co-chairs:** Corey Stephens (FAA)  
Jens Hennig (GAMA)

**Members:** FAA, AOPA, EAA, GAMA, UAA, MFGs,  
FAAST, NAFI, Insurance, Academia, SAFE

- Identify future areas of study/risk
- Charter safety studies
- Provide guidance and direction
- Draw data from various areas
- Develop a prioritized Safety Plan
- Develop metrics to measure effectiveness of safety solutions

## Working Groups

(To include SMEs from various general aviation segments, depending on study)

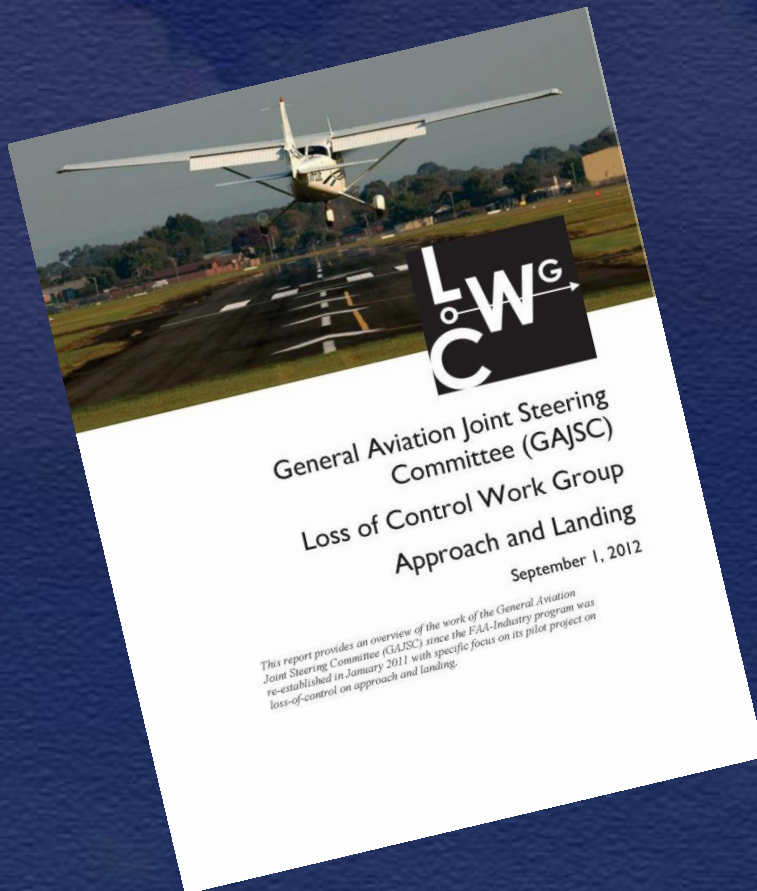
- Data analyses
- Safety enhancement
- Mitigation development

# Loss-Of-Control Working Group

## Safety Enhancements Identified

- AOA – New, Current, Retrofit
- Aeronautical Decision Making
- Stabilized Approach
- Single Pilot CRM
- Medication effects
- Weather Technologies
- Etc...

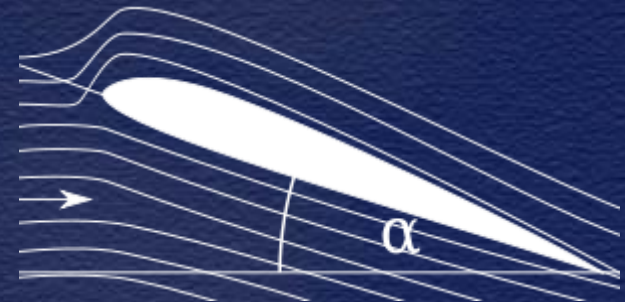
28 Safety Enhancements  
plus  
8 more with second study





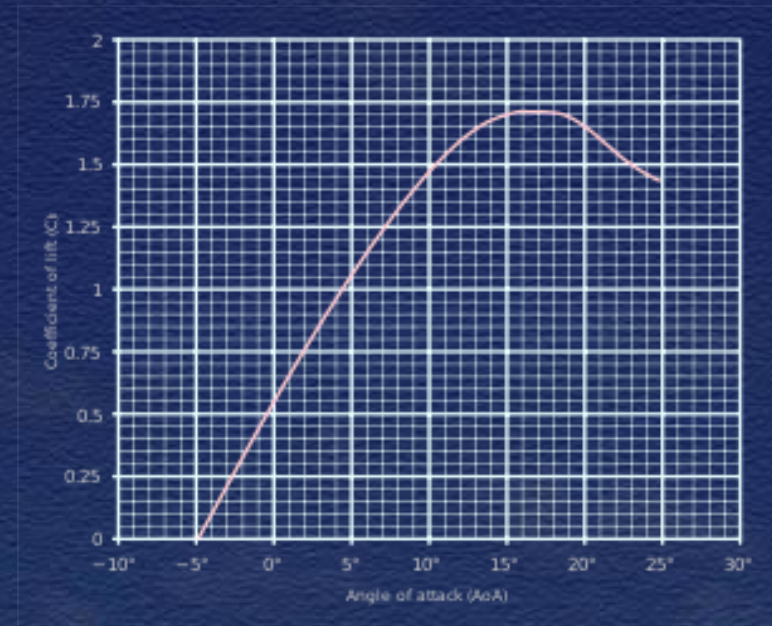
# Lower Cost AOA Displays

- Stall occurs at a specific Angle-of-Attack
  - But not necessarily at the same airspeed

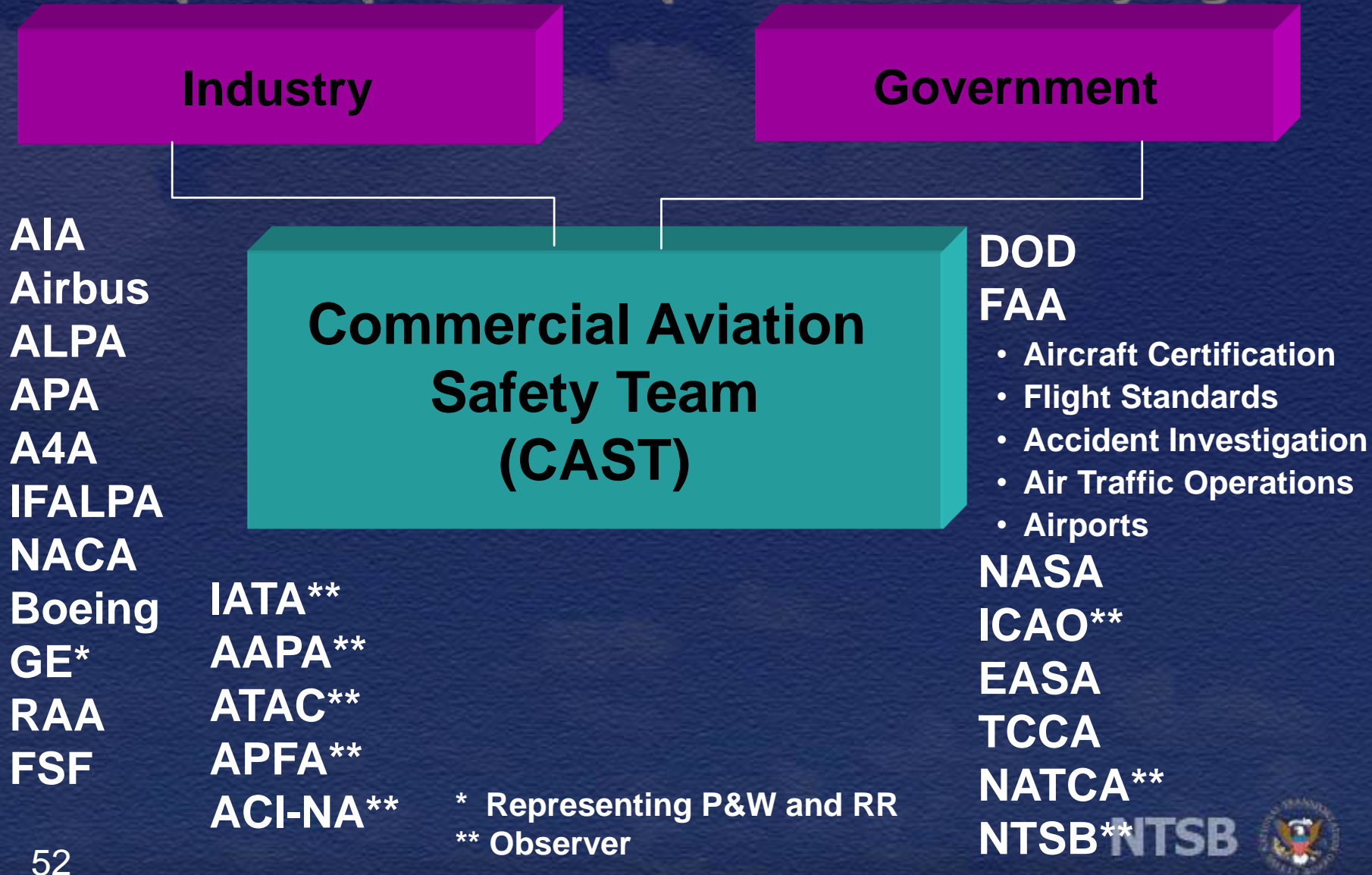


First of AOA indicators built to ASTM stds and installed as a minor mod

FAA  
installation  
policy changed



# CAST brings key stakeholders to cooperatively develop & implement a prioritized safety agenda





# ASIAS Members

## Commercial Air Carriers (46)

ABX Air	ExpressJet	PSA Airlines
Aerodynamics, Inc.	FedEx Express	Republic Airlines
Air Transport Intl.	Frontier Airlines	Shuttle America
Air Wisconsin Airlines	GoJet Airlines	Silver Airways
Alaska Airlines	Hawaiian Airlines	SkyWest Airlines
Allegiant Air	Horizon Air	Southern Air
Aloha Air Cargo	JetBlue Airways	Southwest Airlines
American Airlines	Kalitta Air	Spirit Airlines
Atlas Air	Mesa Airlines	Sun Country Airlines
Cape Air	Miami Air Intl.	Swift Air
CommutAir	Mountain Air Cargo	Trans States Airlines
Compass Airlines	National Airlines	United Airlines
Delta Air Lines	Northern Air Cargo	United Parcel Service
Empire Airlines	Omni Air Intl.	Virgin America
Endeavor Air	Piedmont Airlines	
Envoy Air	Polar Air Cargo	

## Industry

A4A—Airlines for America	NACA—National Air Carrier Association
AIA—Aerospace Industries Association	NATCA—National Air Traffic Controllers Association
Airbus	RAA—Regional Airline Association
ALPA—Air Line Pilots Association	SAPA—SkyWest Airlines Pilot Association
APA—Allied Pilots Association representing Coalition of Airline Pilots Associations (CAPA)	SWAPA—Southwest Airlines Pilots' Association
Boeing	

## General Aviation Operators (30)

Costco Wholesale*	NetJets
Eli Lilly	Northeastern Aviation Corp
Embraer Executive Jets	REVA
Flexjet	Vulcan, Inc.
Flight Options	XOJET
Gama Aviation	18 additional Operators*
Johnson & Johnson	

## Industry

ACSF—Air Charter Safety Foundation	NBAA—National Business Aviation Association
Embraer	NJASAP—NetJets Association of Shared Aircraft Pilots
GAMA—General Aviation Manufacturers Association	
Gulfstream Aerospace	

## Maintenance, Repair & Overhaul

AAR Aircraft Services	HAECO Americas
-----------------------	----------------

## Government

AMC—Air Mobility Command	Naval Air Force Atlantic
FAA	USAF Safety Center
NASA	NTSB

## Academia

University of North Dakota
----------------------------

\*Newest Member

As of 22 August 2016

# Safety Management System

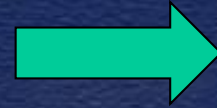
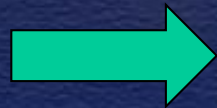
- Safety Policy
- Safety Risk Management
- Safety Assurance
- Safety Promotion



# Changes to Safety Culture

## Reactive & forensic

- Whack-a-mole management
- Crisis safety management
- Silos of knowledge
- Data is collected



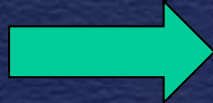
## Risk-based & predictive

- Risk management
- Change management
- Data analysis and information sharing
- Data answers questions

# Changes to Safety Culture

## Reactive & forensic

- “Off with their heads”
- Safety organization responsible for safety
- Regulator is dictatorial and despised
- Safety expected by regulations



## Risk-based & predictive

- Just culture
- Everyone responsible for safety
- Regulator is collaborative and respected
- Safety enhanced via voluntary initiatives



# Douglas Adams

“Human beings, who are almost unique in having ability to learn from the experience of others, are also remarkable for their apparent disinclination to do so.”



**NTSB**



# QUESTIONS OR COMMENTS?

# 2016 MWL – Strengthen Occupant Protection

A factor in all modes:

- Numerous investigations showed potential for reduced injuries & fatalities
- Need
  - Enhance survival space & ease of evacuation
  - Increased use of existing restraint systems
  - Shoulder harnesses for GA aircraft



# 2016 MWL – Promote Collision Avoidance Technologies (CAT) in Highway Vehicles

- Addresses human performance issues
  - Impairment
  - Fatigue
  - Medical conditions
  - **Distraction**
- Introduces new set of issues
  - False alerts
  - Over-dependence

# Types of Crash Avoidance Technologies

- Alerts
  - Lane Departure Warning
  - Stationary Object Alert
  - Following Distance Alert
- Interventions
  - Automatic Emergency Braking
  - Active Steering Assist



# Recorders





# 2016 MWL- Expand use of Recorders

A factor in all modes:

- Critical in accident investigation
  - Install crash resistant image recorders in smaller turbine powered aircraft
  - Install flight recorders in transport category and HEMS aircraft
  - Install inward & outward video cameras in trucks, busses, & trains
  - Use PED memory when available